Implementing a chemical hygiene plan in an integrated pulp and paper mill laboratory

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Review of the elements in our current chemical hygiene plan shows that significant improvements have been made in laboratory employee safety.

On Nov. 25, 1983, the Occupational Safety and Health Administration (OSHA) published the hazard communication standard (29 CFR 1910.1200). Since the tragic Bophal incident in 1984, the regulatory aspect of chemical safety has undergone drastic changes. Hazard communication was followed by SARA, Title III, and other state "right-to-know" legislation. The hazardous waste operation and emergency response standard began to address chemical safety for a group which had not traditionally been considered a part of major industry.

The regulatory trend continues today with the process safety management standard, in which the focus is directed at design, inspection, and operation of process systems involving hazardous materials. The laboratory standard is included in this regulatory avalanche. The basis for this standard is to address serious work practice concerns found in laboratories where exposure to hazardous chemicals can occur.

The intent of the hazard communication standard was to force chemical manufacturers and distributors to evaluate their products in terms of health and safety factors. These factors range from health effects for humans to physical hazards such as fire, explosion, and reactivity. The design was to package this information into a form known as a material safety data sheet (MSDS). In the standard, OSHA required that a minimum amount of data be included on the form and that employers covered by the standard make this information available to their employees.

OSHA received many comments concerning the exclusion of most laboratories from the requirements of the hazard communication standard. A large percentage of laboratory employees were known to be highly educated and were expected to take it upon themselves to develop and maintain good work practices, especially where safety was concerned. A working knowledge of the hazards of the chemicals in use was considered to be a corollary of the large percentage of professionally trained employees. Additionally, laboratories were viewed as areas where only small quantities of chemicals were used, certainly not the tons of chlorine, sulfuric acid, and other hazardous chemicals processed and shipped daily in manufacturing areas. OSHA intended to eventually regulate laboratories but had set its immediate sights on the sector where relatively large quantities of chemicals were handled by people who could be less aware of health hazards than laboratory professionals.

Once a working basis had been established with the hazard communication standard, OSHA began to address other areas such as hazardous waste operations, emergency responders, and laboratories. As a result of this scrutiny, on Jan. 31, 1990, the Department of Labor published in the Federal Register an amendment to 29 CFR 1910, Subpart Z, identified as Section 1450. The title of that amendment is "Occupational Exposure to Hazardous Chemicals in the Laboratory," better known as the laboratory standard. The effective date of the laboratory standard was May 1, 1990. As part of the standard, a requirement was included for the development and implementation of a chemical hygiene plan by Jan. 31, 1991.

The chemical hygiene plan

The chemical hygiene plan (CHP) is defined as "a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e)" (*1*). These additional requirements include capability for keeping exposures below limits and availability of the plan to laboratory employees, as well as:

- Standard operating procedures relevant to safety and health
- Criteria for control measures
- Requirement for proper functioning of fume hoods and other protective equipment
- Provisions for employee information and training
- Description of circumstances requiring prior approval
- Provisions for medical consultation and examination

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I. The site-specific plan included these topics

- Responsibilities
- Standard operating procedures
  - General rules
  - Personal hygiene
  - Food and smoking
  - Protective clothing and equipment
  - Housekeeping
  - Prior approval
  - Spills and accidents
  - Waste chemicals
- *Procedure-specific safety procedures*
- Control measures and equipment
  - Ventilation
  - Safety cans
  - Flammable storage cabinets
  - Eyewashes and safety showers
  - Personal protective equipment
  - Respirators
  - Vapor detection
- Procedures for carcinogens, reproductive toxins, substances with a high degree of acute toxicity and chemicals of unknown toxicity
  - Regulated and controlled work areas
- Criteria for control measures
  - Exposure
  - Fire
  - Reactivity
  - Corrosivity and contact
- Exposure evaluation
- Medical consultation
- Employee information and training
- Records and recordkeeping

- Designation of personnel responsible for implementing the plan
- Special procedures for handling of carcinogens, teratogens, and highly toxic substances.

The plan applies to employees and activities which match OSHA's definition of "laboratory use of hazardous chemicals."

Description of the laboratory

Chesapeake Paper Products Co., a subsidiary of Chesapeake Corp., is located in West Point, VA. The mill processes wood and recycled fiber into bleached hardwood pulp, corrugating medium, kraft paper, paperboard, and specialty products for the paper and packaging industry.

The analytical laboratory is a service group within the technical department. The laboratory primarily provides analytical support to other technical department members, the various production areas, and the sales service and product development departments. Occasionally, analytical support extends beyond West Point operations and is provided to the corporation at large. The laboratory conducts an assortment of analyses and tests to evaluate mill processes, product quality, raw materials, and environmental quality.

The laboratory physical plant consists of a main lab area, a basement storage area, a wastewater laboratory area, and five office spaces. The main lab is attached to the main office building. It extends over approximately 6400 ft^2, including four small, peripheral rooms opening onto the main bullpen area, which is filled with work benches containing cabinets and sinks. Part of this main room has been partitioned off for use by the process engineering group. The storeroom area lies directly beneath the main lab. The wastewater lab is located separately in a nearby building. It covers approximately 550 ft^2.

The current laboratory staff of 12 includes chemists and laboratory technicians with educational backgrounds ranging from high school diploma to masters degree in chemistry.

The site-specific plan

The process of developing a site-specific CHP began with a review of the areas in our organization to which the standard applied. Pilot-plant and quality control laboratory operations are not included in the standard's definition of laboratory use, so there was some question about whether the standard applied. Upon further consideration of the definition, the analytical laboratory was determined to be covered mainly by virtue of the number and diversity of procedures in use and the protective equipment in place. However, areas in the mill where limited and repetitive testing closely tied to the production process is performed were not considered to fall within this definition. Additionally, process engineering laboratory activities, which involve simulation of production processes, were considered to be specifically excluded.

Upon determining that a CHP was necessary, a chemical hygiene officer was appointed and directed to prepare the plan. Consideration was given to whether this appointment should be filled by an industrial hygienist or a representative of the laboratory group. A chemist from the laboratory was selected for this responsibility because of his more intimate knowledge of laboratory operations. The chemical hygiene officer has, however, worked closely with the industrial hygiene office, and all aspects of the plan and its implementation have been reviewed and approved by them. Additionally, areas of responsibility defined in the plan are assigned to industrial hygienists.

Resources for preparing the plan were available in the literature (*2–4*), and some further guidance was obtained through attendance at a seminar sponsored by a laboratory chemical supplier. The majority of the provisions required by the standard were found to be in place in some form at the time the plan was prepared. The CHP became, in part, a tool for coordinating these existing safety activities and procedures, and it also served as a stimulus for a concerted evaluation of the condition of the laboratory in terms of employee safety.

A somewhat generic plan evolved from this process which

addressed each of the requirements listed in the standard. It resembled those examples and models from the literature and Appendix A to the standard. The site-specific plan was arranged into the sections and subcategories listed in **Table I.**

The plan was reviewed and approved by the laboratory manager, but we anticipated that as the plan was reviewed and revised it would be modified to accommodate any special requirements that may not have been apparent at the time of initial preparation.

Implementation of the plan

Copies of the CHP were distributed to all personnel with responsibilities described in the plan. Additional copies were located in each laboratory area and in the MSDS file area. Copies were numbered serially, and a file was kept by the chemical hygiene officer listing the location and the individual responsible for each copy.

To ensure that all laboratory employees were aware of the plan, a copy was routed to each one along with a sign-off sheet acknowledging that the plan had been read and understood. Prior to the deadline for implementation, a training session was held for all laboratory employees. A presentation was made by the chemical hygiene officer, along with the senior industrial hygienist, which specifically addressed each of the requirements in the standard relative to employee information and training. A videotape presentation on hazard communication and laboratory safety was included in the program.

Finally, a meeting was held to verify responsibilities defined in the plan with the accountable personnel and to discuss the formation of a chemical hygiene committee and other relevant issues.

Initial laboratory audit

Once the plan was approved and in place, an audit was performed using requirements set forth in the plan as guidelines. As noted previously, most of the provisions already were in place. A report was prepared and submitted to the laboratory manager listing findings and recommendations in each of the areas addressed in the CHP.

The written plan was considered to be adequate. However, we recommended that the plan be endorsed by management at a higher level than the laboratory manager. OSHA requirements for training and information had been met as of the time of the audit. Additional hands-on training in the use of emergency equipment was recommended. A respirator program in compliance with 29 CFR 1910.134 was already in place, as were provisions for medical consultation, examination, and record keeping.

A ventilation survey on laboratory fume hoods was conducted by industrial hygiene. Air velocity was measured in each of 16 positions in a grid marked out on each hood opening. The measured velocity in each position was posted, along with the average face velocity, on each hood. Not all hoods met the target velocity of 70–100 ft/min average, largely due to the obstruction of air flow by pieces of large equipment such as muffle furnaces, autoclave, Leco combustion analyzer, etc., in some hood areas.

We recommended that, where possible, large equipment be removed from hoods. Also, where the equipment required venting, those hoods would be designated for that equipment and not used for any other operations. A canopy hood in the main laboratory was tested using indicating smoke. This hood was recommended for use only for odor concerns where no health hazards exist. A regular maintenance inspection was requested to ensure proper working condition of all ventilation system components. We noted that the room containing the gas chromatographs (GC) and the ion chromatograph did not contain any hood or other ventilation device. We recommended that ventilation be installed in this area or that this equipment be relocated. Exhaust systems for the two atomic absorption spectrophotometers were found to be in good working order.

Emergency fire equipment was found to be adequate in most laboratory areas. Safety personnel inspect and sign off on fire extinguishers, safety showers, and eyewashes on a regular basis. One old eyewash station in the lab was found to employ a spring-loaded valve which had to be held open to maintain water flow. We recommended that this eye wash be modified or replaced. Another recommendation was that some additional signs be placed in laboratory areas. Doors which do not allow exit from the area required marking as "not an exit." Self-illuminating exit signs and emergency lighting also were recommended.

Under emergency action procedures, the only recommendations made were that emergency evacuation drills be performed on a regular basis and that floorplan diagrams showing exit routes be posted.

All laboratory operations were evaluated in terms of potential for exceeding control limits which would require air monitoring. This potential was identified in two areas involving laboratory personnel. One was a sampling location in the wastewater treatment plant where hydrogen sulfide levels were suspected to be high, and the other involved possible hydrogen sulfide generation during a step in a routine analytical procedure. Monitoring during the analysis in question proved that levels were far below the permissible exposure limit (PEL). A permanent, remote reading, monitoring instrument was installed at the sampling point in the wastewater treatment plant. Levels can be determined in that area prior to entry, and any levels approaching the PEL will activate an alarm.

The largest number of deficiencies noted in the audit involved storage and labeling of chemicals. The chemical storeroom has been in its current location for at least 15 years, and many of the chemicals were relocated from previous storage areas. Dry chemicals were found to be arranged in alphabetical order. Acids and bases were not separated adequately, and sufficient consideration had not been given to segregation of reactive combinations.

The flammable liquid storage room was located in the basement and was judged to be inadequate for the volume it contained. Several deficiencies were noted in design and construction of this area. Flammable liquids in the laboratory also were found to be improperly stored. The National Fire Protection Association (NFPA) diamond system was in use for laboratory labeling. Additionally, MSDSs were not on file for many of the older chemicals found in the storeroom. We recommended that the MSDS file be updated, the flammable liquid storage area be upgraded or replaced, an approved storage cabinet be installed in the main laboratory, and all chemicals in the storeroom be

rearranged into an approved configuration based on hazard categories.

Other problems were noted in the category of housekeeping. Some fume hoods were being used for storage and material was present in aisles and at the end of shelves in the storeroom. General housekeeping in the main laboratory area was considered to have room for improvement. Recommendations for improved practices and regular inspections were made.

At the time of the audit, several desks were located in an area just off the main laboratory. No physical barrier such as a door between this area and the laboratory was present, and personnel occasionally had food and drink at their desks. Although this area might in some sense be considered separate from the laboratory, a change was recommended.

The laboratory was considered by the auditors to be extensively in compliance with provisions of the CHP with few exceptions. The main areas of concern for us were flammable liquid storage, repositioning of the GCs, maintenance and cleanup of fume hoods, and the separation of laboratory and office areas.

Corrective action

Laboratory management has continued to actively support efforts to improve safety and endeavored to follow the recommendations made in the audit report in all cases. Some changes were relatively easy to make, such as relocating the desks and GCs, while others required considerable time and expense.

A new combination eyewash/safety shower was installed in place of the eyewash with the defective valve. Additional signs were installed in several locations within the laboratory and chemical storage areas. Concrete pads were poured, and racks were fabricated for proper storage of compressed gas cylinders in separate areas according to OSHA requirements.

The single largest expense involved the purchase and installation of a factory-mutual-approved flammable storage building which met all applicable OSHA, NFPA, and local fire code requirements. This purchase was considered to be more cost effective than modifying the existing flammable liquids storage room. A new flammables storage cabinet was installed in the main laboratory as part of this change. The addition of the building allowed us to relocate our corrosives storage to the old flammables storage room. This allowed separation and mechanical ventilation in the event of a spill. The additional space was another benefit of the building purchase which assisted in the reorganization of the remaining chemicals.

The NFPA labeling system, while providing information on acute hazards and reactivity with water, was not entirely adequate for the safe use of chemicals in the laboratory, where additional concerns such as chronic exposure effects and personal protective equipment requirements are a consideration. Several alternative systems were evaluated based on ease of use, completeness of information, and acceptance in the industry. Although we did not initially wish to limit ourselves to a single vendor's system, we have implemented the labeling system used by our current reagent supplier. The American National Standards Institute (ANSI) system seemed somewhat complex, and materials for applying it were not readily available. We are continuing to seek out alternative systems to better suit our needs. One area of interest involves a software package which includes approximately 3000 MSDSs in a database with inventory control capabilities and generates labels with hazard information upon request.

The entire chemical storage area was inventoried, and a letter-writing campaign to chemical suppliers was initiated to update our MSDS file. With a single exception, all distributors and manufacturers contacted were more than cooperative, and MSDSs were received and filed for all of our chemicals. Binders containing the sheets were relocated from a file cabinet to a bookshelf in the laboratory for easier access and visibility.

Annual review

Our review process is ongoing. Revisions to the plan at this time include updating drawings, adding document control and revision history to the plan, and updating housekeeping operations. The original decision that a chemical hygiene committee was not necessary (in addition to existing safety committees and groups) has been changed. Laboratory management has at this time agreed to this action, and steps are in progress for its implementation.

There were three minor exposure incidents during the first year of the plan. The first involved skin contact with a fairly innocuous reagent which was spilled. The bottle had been stored above eye level. No medical consultation or examination was required. The other two incidents involved liquids splashed into the eye. The victim was sent to the doctor for medical examination in one of these instances and released without any further treatment. Safety glasses with side shields were being worn in both instances. Splash goggles would have prevented both of the exposures.

There had been some opposition to requiring chemical splash goggles at the time the CHP was approved, especially since OSHA was not known to have referenced the ANSI (*5*) requirements into any regulations. After the second eye exposure incident, we now require that goggles be worn as minimum eye protection at all times while handling hazardous liquids.

In each of the exposure incidents, the procedures for exposure evaluation outlined in the plan were followed without any problems.

Conclusions

Reviewing safety progress during the past year in our laboratory operations leads to the conclusion that the new regulation and the plan that it required have played a role in improving employee safety. In many instances, the changes described above would have been made without any new regulatory requirements. The premise that laboratory professionals are aware of hazards and are capable of managing a safe operation is valid in many cases. Where a laboratory functions within a production facility, however, other interests must be addressed. The standard has helped us focus attention on hazardous chemicals in the laboratory. It has also given us a framework to bring together existing safety proce-

dures and programs into a more cohesive program. With the cooperation of management, it has been possible to use this vehicle to correct unsafe conditions and to increase awareness of chemical hazards in our work environment. □

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